

Before the
FEDERAL COMMUNICATIONS COMMISSION **RECEIVED**
Washington, D.C. 20554

JUL 25 1995

In the Matter of)	FEDERAL COMMUNICATIONS COMMISSION
)	OFFICE OF SECRETARY
Allocation of Spectrum in the 5 GHz Band)	RM-8653
To Establish a Wireless Component of the)	
National Information Infrastructure)	
Petition for Rulemaking to Allocate)	RM-8648
the 5.1 - 5.35 GHz Band and Adopt)	
Service Rules for a Shared Unlicensed)	
Personal Radio Network)	DOCKET FILE COPY ORIGINAL

COMMENTS OF APPLE COMPUTER, INC.

James F. Lovette
Principal Scientist,
Communications Technology
APPLE COMPUTER, INC.
One Infinite Loop, MS: 301-4J
Cupertino, California 95014
(408) 974-1418
jlovette@apple.com

OF COUNSEL:

Henry Goldberg
Mary J. Dent
GOLDBERG, GODLES, WIENER & WRIGHT
1229 Nineteenth Street, N.W.
Washington, D.C. 20036
(202) 429-4900

James M. Burger
Director, Government Affairs
APPLE COMPUTER, INC.
1667 K Street, N.W., Suite 410
Washington, D.C. 20006
(202) 466-7080

July 25, 1995

TABLE OF CONTENTS

Summary	i
I. The Comments Reflected Very Strong Support For The Petitions.	2
II. The Limited Reservations Expressed By A Small Number Of Commenting Parties Either Lack Merit Or Should Be Addressed In The Context Of A Rulemaking Proceeding.	4
A. Inter-Service Sharing Issues Should Be Addressed As Part Of The Rulemaking Process.	4
B. Community Networks Are An Essential Part Of The NII Band.	8
C. 300 MHz Of Unlicensed Spectrum In the 5 GHz Range Is Required To Satisfy The Predicted Need For Wireless, Broadband Connections.	11
D. Technical Rules Should Be Developed During The Rulemaking Process.	13
E. Pulson's Alternative Proposal Should Be Rejected.	13

SUMMARY

Recent statements by Chairman Hundt stressing the importance of networking, the role of schools and libraries in tomorrow's information economy, and the FCC's role in preserving broad access to the spectrum resource, echo the sentiments of more than two hundred and twenty-five individuals and groups who filed comments supporting the Petitions filed by Apple and WINForum for a new, broadband unlicensed wireless communications service.

People from across the country, speaking on behalf of schools, libraries, state and local governments, disabled persons, civic networks, communities, small businesses, equipment manufacturers, and individual users described the array of benefits that could be achieved through an allocation of unlicensed spectrum capable of carrying a mixture of communications and applications, including those requiring high-bandwidth and longer distance links.

Of particular interest to Apple was the strong support for the fundamental concept underlying its NII Band proposal: that the spectrum must be shared equitably by all users, without preclusive priority for any type of user or type of communication.

In sum, the comments reflected virtually unanimous agreement that: (1) unlicensed services are an essential part of the NII, (2) other technologies and services will not adequately serve the full range of communications needs across geography, income, and type of use, and, as a result, (3) unlicensed services must be given the opportunity to flourish through appropriate, adequate spectrum allocations.

A few entities expressed limited reservations to the proposals set out in the Petitions. In particular, several existing and proposed users of the 5 GHz bands expressed concerns that unlicensed devices could cause unacceptable interference to their operations. Apple does not propose that any existing or planned user be relocated from the 5 GHz band. Apple also concurs that additional work must be done to document the existing and planned uses of the 5 GHz band and to determine the circumstances under which sharing between these users and new, unlicensed devices will be possible. Apple believes,

however, that sharing solutions are possible, and that these issues must be addressed on their merits in the context of an FCC rulemaking proceeding.

A very small number of commenting parties recommended that the FCC exclude "community networks" from the proposed NII Band. These arguments ignore the fact that many links within community networks, and indeed many entire community networks, will never be built, and their potential users will remain unserved, if unlicensed services are not available as an option. They also ignore the spectrum inefficiencies associated with mandating that users employ a dedicated link when their needs could be met using a shared unlicensed band, as well as the fact that unlicensed community network links are not mutually exclusive with one another or with more traditional, smaller area unlicensed networks.

Finally, the comments reflect broad agreement that the FCC should adopt an NPRM that proposes the broad outlines for regulating the NII Band, but should give a representative industry body responsibility for developing the specific technical rules governing the NII Band.

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554**

In the Matter of)	
)	
Allocation of Spectrum in the 5 GHz Band)	RM-8653
To Establish a Wireless Component of the)	
National Information Infrastructure)	
 Petition for Rulemaking to Allocate)	RM-8648
the 5.1 - 5.35 GHz Band and Adopt)	
Service Rules for a Shared Unlicensed)	
Personal Radio Network)	

REPLY COMMENTS OF APPLE COMPUTER, INC.

The key feature of the information highway is going to be networking...it will be networks that will weave homes, government, schools, hospitals and businesses into a national community.... I see the schools and libraries as the sparkling points, a thousand public hearths attracting community members to the light of the national information network.... Our common job, then, is to hook up the libraries and classrooms."¹

"[W]hat is the purpose of the FCC[?] First, the FCC manages the public property of the airwaves to promote the public interest. This means, among other things, that we make sure that new businesses and small businesses have a chance to gain access to spectrum. Without us, the big established companies would be in total control of the communications revolution. These are fine companies but they shouldn't be the only ones involved in the most important industry in this country's future."²

These recent statements by Chairman Hundt echo the sentiments of more than two hundred and twenty-five individuals and groups who filed comments

¹ Speech by Reed E. Hundt, Chairman, Federal Communications Commission, Annual Legislative Conference, National Association of Counties, Washington, D.C. (March 5, 1995).

² Remarks of Chairman Reed E. Hundt, American Mobile Telecommunications Leadership Conference (June 27, 1995) (as prepared for delivery).

supporting the petitions of Apple Computer, Inc. ("Apple") and the Wireless Information Networks Forum ("WINForum") for a new, broadband unlicensed wireless communications service (the "Petitions").³ People from across the country, speaking on behalf of schools, libraries, state and local governments, disabled persons, civic networks, communities, small businesses, equipment manufacturers, and individual users urged the FCC to create a "public lane" on the information superhighway. While the specific statements varied from commenter to commenter, the comments almost universally expressed strong support for prompt action.

I. THE COMMENTS REFLECTED VERY STRONG SUPPORT FOR THE PETITIONS.

The comments described an array of benefits that could be achieved through an allocation of unlicensed spectrum capable of carrying a mixture of communications and applications, including those requiring high-bandwidth and longer distance links. Broadband unlicensed wireless connections could promote education,⁴ offer new possibilities for libraries to serve as information "gateways,"⁵ enhance opportunities for public dialog,⁶ enable small companies

³ It would be impossible for Apple to cite to each of the individual comments that discussed the need for the NII Band or the benefits that this band could provide to users. Apple has included representative — but not exhaustive — citations, but intends no slight to the many supportive comments filed with the FCC that are not mentioned in this brief reply.

⁴ E.g., Comments of the Council of Chief State School Officers; Joint Comments of the Education Organizations (the American Educational Research Association, the Software Publishers Association, the Triangle Coalition for Science and Technology Education, and the National School Boards Association); Comments of Sheri Edwards; Comments of Rodger Hendricks, Center for Instructional and Research Computing Activities, University of Florida; Comments of the National Education Telecommunications Organization/the Education Satellite Institute; Comments of Bruce Umbaugh, Assistant Professor of Philosophy, Webster University; Comments of Mark D. LeBlanc, Wheaton College; Comments of Microsoft Corporation at 3; Comments of Metricom Inc. at 5.

⁵ E.g., Comments of the American Library Association; Comments of the Eastern Shore Public Library; Comments of Mike McGuire, Director, Traverse Area District Library; Comments of Chris Mays.

⁶ E.g., Comments of Americans Communicating Electronically; Comments of M. Carling, Chairman, Bay Area NeXT Group; Comments of the Center for Democracy and Technology ("CDT"); Comments of Duncan, Weinberg, Miller & Pembroke, P.C. ("Duncan, Weinberg"); Comments of the Electronic Frontier Foundation; Comments of Thomas E. Kunselman; Comments of Michael Chui, Executive Director, HoosierNet; Comments of Sue Beckwith, Executive Director, Austin Free-Net.

to design and deploy cost-effective networks suited to their needs,⁷ create opportunities for small businesses to participate in the information/communications economy,⁸ link rural and low income communities and those with special needs to the broader information infrastructure,⁹ promote community development,¹⁰ improve health care,¹¹ and improve energy use and promote conservation.¹² Importantly, the NII Band would achieve these benefits using a market-based solution, without government mandates and without government subsidies, other than dedication of the required spectrum.

Moreover, Apple's proposed NII Band would promote full use of scarce spectrum resource,¹³ spur innovation in wireless technologies,¹⁴ promote interoperability with the European HIPERLAN allocation and create new export opportunities,¹⁵ enhance U.S. technological leadership,¹⁶ and increase business productivity.¹⁷

⁷ E.g. Comments of Cannon Research at 1; Comments of Rob Narberes, Lab Services Supervisor, DNA Plant Technology Corporation; Comments of John Fix 3rd, Owner, Cornell's True Value Hardware; Comments of John R. Levie.

⁸ E.g., Cannon Research Comments at 1; Comments of Kenneth J. McCarthy, President, e-media; Comments of Kent Borg; see also Comments of Walker M. Lomia, a professional software engineer and researcher, Software Engineering Institute, Carnegie Mellon University.

⁹ E.g. Comments of David A. Ross, Senior Biomedical Research Engineer, Department of Veterans Affairs Medical Center (Atlanta); Comments of Gary W. Kelly; Comments of Microsoft Corporation at 2; Comments of Michael Gersten; Comments of Susan D. Prince; Comments of Michael Papadopoulos, Ph.D.; Comments of James G. Kimball; Comments of Robert Brewer. Mr. Ross and Mr. Kelly's comments, in particular, provide a fascinating overview of the ways in which unlicensed wireless technologies could be used to improve the quality of life for aging veterans and disabled persons.

¹⁰ E.g. Comments of Aaron Laramore, Executive Director, Organized Neighbors Yielding Excellence, Inc. ("Laramore"); Comments of Noel Dunne, Director, SLU Christian Community Services; Comments of Marna Hauk.

¹¹ E.g. Comments of Michael Silverberg, Associate Professor of Medicine, Stony Brook Health Sciences Center; Microsoft Comments at 3; Metricom Comments at 4-5.

¹² Metricom Comments at 4.

¹³ E.g. Comments of Andrew Corporation at 3.

¹⁴ E.g. Andrew Comments at 3-4.

¹⁵ E.g. Andrew Comments at 8; Comments of Compaq Computer Corporation at 3; Comments of Digital Microwave Corporation at 2; Comments of Harris Corporation - Farinon Division at 1, 3-4; Comments of Hewlett-Packard Company ("HP") at 5-6; Comments of the Information Technology Industry Council ("ITI") at 2; Comments of Motorola, Inc. at 3; Comments of Northern Telecom Inc. ("NTI") at 3; Comments of Kent Borg.

¹⁶ e-media Comments at 1; HP Comments at 5; Microsoft Comments at 1; Comments of Tetherless Access Ltd. ("TAL") at 5.

¹⁷ NTI Comments at 3.

Of particular interest to Apple was the strong support for the fundamental concept underlying its NII Band proposal: a spectrum allocation that is available to all technologies operating in conformance with an agreed-upon set of technical rules designed to assure equitable sharing of the spectrum resource, without preclusive priority for any type of user or type of communication.¹⁸

In sum, the comments reflected virtually unanimous agreement that: (1) unlicensed services are an essential part of the NII; (2) other technologies and services — both wired and licensed-wireless — will not adequately serve the full range of communications needs, across geography, income, and type of use; and, as a result, (3) unlicensed services must be given the opportunity to flourish through appropriate, adequate spectrum allocations.

II. THE LIMITED RESERVATIONS EXPRESSED BY A SMALL NUMBER OF COMMENTING PARTIES EITHER LACK MERIT OR SHOULD BE ADDRESSED IN THE CONTEXT OF A RULEMAKING PROCEEDING.

A. Inter-Service Sharing Issues Should Be Addressed As Part Of The Rulemaking Process.

Several existing and proposed users of the 5 GHz bands filed comments on one or both of the Petitions expressing concerns that unlicensed devices could

¹⁸ E.g. Laramore Comments at 2; Andrew Comments at 1, 9; Cannon Research Comments at 1; CDT Comments at 6; Digital Microwave Comments at 3; Duncan, Weinberg Comments at 3; Comments of Knowledge Industries at 1; Comments of the Part 15 Coalition at 2, 8; TAL Comments at 3, 4; Compaq Comments at 3; Metricom Comments at 8.

cause unacceptable interference to their operations.¹⁹ Several other parties supported the Petitions, but agreed that sharing issues must be addressed.²⁰

Apple concurs that additional work must be done to document the existing and planned uses of the 5 GHz band and to determine the circumstances under which sharing between these users and new, unlicensed devices will be possible. That said, however, Apple believes that it is important to place the sharing situation in context.

First, Apple has not proposed that any existing or planned user be relocated from the 5 GHz band.²¹ Its recommendation that NII Band devices be regulated under a "Part 16" structure and be afforded co-primary status is intended to provide certainty to all users — both NII Band and others — by developing mutually acceptable sharing solutions that would govern future operation in the band. Apple does not propose that NII Band technologies would receive preferential treatment over any existing user or type of usage.

Second, the Commission should give no weight to any recommendation that it reject Apple's proposal prior to investigating sharing opportunities in a

¹⁹ One "Big LEO" licensee, Loral/Qualcomm Partnership, L.P. ("LQP") opposed the Petitions due to concerns about potential interference to its proposed 5 GHz feeder links. Another Big LEO applicant, Constellation Communications, Inc. ("Constellation"), filed comments suggesting that further sharing studies are required. The Federal Aviation Administration ("FAA") opposed WINForum's proposed use of the 5000-5150 MHz band, but did not oppose unlicensed use of the 5150-5250 MHz band on a secondary basis if sharing studies show that unlicensed devices can co-exist with planned aeronautical radionavigation safety systems. Finally, several Amateur Radio Service users and organizations filed comments expressing concerns about potential interference to Amateur Radio Service users. Comments of the American Radio Relay League, Incorporated ("ARRL"); Comments of William J. Kaiser; Comments of the Northern Amateur Relay Council of California, Inc. ("NARCC"); Comments of David M. Shaw; Comments of Samuel F. Wood.

²⁰ Notably, several Amateur Radio Service users supported the NII Band Petition, although they generally agreed that suitable sharing solutions should be developed. See Comments of Francis A. Ney, Jr.; Comments of Ed Epley; Comments of Dewayne Hendricks; Comments of Richard Hodges; Comments of Bruce Perens. See also Comments of the Southern California Repeater and Remote Base Association at 16 ("SCRRBA") (expressing strong concerns about sharing issues but agreeing that "[t]he basis concept is of sufficient merit that further consideration should occur").

²¹ See ARRL Comments at 2-3; NARCC Comments at 5; SCRRBA Comments at 9, 11-12, 13, 14; David Shaw Comments.

rulemaking proceeding.²² There is insufficient information for Apple, or the Commission, to identify, characterize, and resolve all potential interference issues at this stage of the proceeding. Many uses are currently in the design or development stage or are part of non-public communications networks. Sharing solutions, therefore, can be developed only through discussions with affected parties. After the FCC issues an NPRM, these parties will have the opportunity to provide the necessary information about and resolve sharing issues.²³

Finally, while incumbent users have a legitimate expectation that their needs will be accommodated in authorizing new spectrum uses, they do not have the right to exclusive use of the band.²⁴ As a result, the FCC should reject claims that overstate the risks of interference,²⁵ that seek to limit the use of bands other than those a party is authorized to use,²⁶ or that unreasonably would delay or restrict implementation of the NII Band.²⁷

²² See LQP Opposition at 3, 5; ARRL Comments at 2-3, 10, 12-13; cf. William Kaiser Comments at 1; NARCC Comments at 6.

²³ Sharing issues are commonly addressed during a rulemaking process — for example, as LQP is aware, inter-service sharing issues were a major focus of the FCC's MSS Above 1 GHz Negotiated Rulemaking Committee. Contrary to Constellation's suggestion, Constellation Comments at 5-6, a separate NOI is not required, and would only insert needless costs and delays into the process. Contrary to the concerns of some Amateur Radio Service operators, Apple does not propose a headlong rush by NII Band devices into the 5 GHz bands, and recognizes that Amateur Radio Service operators must be part of the process of defining the NII Band rules.

²⁴ For example, several existing spectrum users — including the GLONASS system, MLS system, and radioastronomy users — each spend years of effort and made accommodations in order to permit the deployment of Big LEO systems. See LQP Opposition at 6, 7; Amendment of the Commission's Rules to Establish Rules and Policies Pertaining to a Mobile Satellite Service in the 1610-1626.5/2483.5-2500 MHz Frequency Bands, Report and Order, CC Docket No. 92-166, 9 FCC Rcd 5936 (1994).

²⁵ For example, global MSS systems will have to design feeder link stations that are capable of operating in spectrum shared with European HIPERLAN devices and, therefore, it is reasonable to use HIPERLAN-based sharing solutions as a starting point for discussing NII Band-based sharing solutions. But see LQP Opposition at 9-10.

²⁶ For example, Constellation opposes any allocation in the 5000-5350 MHz band, even though it proposes to operate only in the 5000-5250 MHz band. See Constellation Comments at 2, 5. Constellation did not limit its opposition to NII Band operation in the 5250-5350 MHz band to concerns regarding out-of-band emissions and adjacent channel interference.

²⁷ For example, LQP said that the FCC should defer action on the Petitions until it and other MSS systems intending to use the 5 GHz band have obtained uplink authorizations throughout the world. LQP Opposition at 9. This is entirely unnecessary, since non-U.S. feeder link operations would be unaffected by the Apple and WINForum proposals, and such an approach could delay any action for years.

Some of the commenters also leveled incorrect criticisms at the Petitions, apparently in an effort to discredit them and, thereby, avoid the need to discuss sharing solutions. A few alleged that, because operation will occur on an unlicensed basis, the band will become an unworkable "free for all" and sharing solutions will be unenforceable.²⁸ This claim ignores the role that mandatory technical standards — adopted and updated through industry consensus, endorsed by the Commission, integrated into each product, and enforced through the Commission's equipment authorization process — will play in protecting equitable access to the spectrum resource and implementing sharing solutions. Using technology rather than rules and regulations as the basic means of "enforcing" spectrum sharing is a workable sharing model that promotes innovation and, for this reason, is a model that the Commission increasingly is using.²⁹

Similarly, ARRL's suggestion that the Commission has no legal authority to allocate spectrum for unlicensed operation ignores both history and the Communications Act's express requirements.³⁰ The FCC first authorized operation on an unlicensed basis in 1938³¹; more recently, it has allocated spectrum specifically for unlicensed operation in the 1910-1930 MHz band and the 2390-2400 MHz band, and has proposed to allocate additional unlicensed spectrum in the bands above 40 GHz. These allocations are entirely consistent with the Act and, in fact, respond to the Act's mandate that the FCC must "[s]tudy new uses for radio ...and generally encourage the larger and more effective use of radio in the public interest"³² and "encourage the provision of new technologies and services to the public."³³

²⁸ See ARRL Comments at 8; Constellation Comments at 4.; William Kaiser Comments at 4; LQP Opposition at 2, 5-6; SCRRBA Comments at 9.

²⁹ See, e.g., 47 C.F.R. §§15.301 *et seq.* (unlicensed PCS rules); Amendment of Parts 2 and 15 of the Commission's Rules to Permit Use of Radio Frequencies Above 40 GHz for New Radio Applications, Notice of Proposed Rulemaking, ET Docket No. 94-124, 9 FCC Rcd 7078, ¶ 14 (1994) (discussing use of low power and spectrum sharing etiquette to avoid potential interference).

³⁰ ARRL Comments at 3-5.

³¹ Revision of Part 15 of the Rules Regarding the Operation of Radio Frequency Devices Without an Individual License, First Report and Order, GEN Docket No. 87-389, 4 FCC Rcd 3493 ¶2 (1989).

³² 47 U.S.C. § 303(g).

³³ 47 U.S.C. § 157(a).

Finally, Loral claimed that the FCC's decision not to propose a High Speed Wireless Data Service ("HSWDS") allocation agenda item at the upcoming WRC-95 conference somehow indicates a policy preference for MSS feeder links and against HSWDS systems. This grossly overstates the case.³⁴ In its decision, the FCC essentially decided to resolve the remaining MSS feeder link issues before addressing a HSWDS allocation at the international level, in order to avoid unnecessarily complicating matters at WRC-95. The FCC did not, however, decide not to proceed domestically with the allocations proposed in the Petitions.³⁵ Because the allocations proposed in the Petitions do not, at least initially, require an international allocation³⁶ or threaten MSS feeder link operations,³⁷ the FCC can move forward on the NII Band proposal without waiting for the conclusion of WRC-95 or undermining the United States' position at WRC-95.

B. Community Networks Are An Essential Part Of The NII Band.

A very small number of commenting parties recommended that the FCC exclude "community networks" from the proposed NII Band. Specifically, the fixed microwave interests — Alcatel Network Systems, Inc. ("ANS"), Digital Microwave Corporation, Harris Corporation - Farinon Division, and the Fixed Point-to-Point Communications Section, Network Equipment Division of the Telecommunications Industry Association — argued that the FCC should force those employing point-to-point paths to use licensed fixed microwave systems rather than the NII Band. In addition, LQP urged the FCC to restrict outdoor use

³⁴ See LQP Opposition at 2-3, 6-9; see also ARRL Comments at 8-9.

³⁵ See Preparation for International Telecommunication Union World Radiocommunication Conferences, Report, IC Docket No. 94-31, ___ FCC Rcd ___, ¶ 97 (June 15, 1995) (specifically referencing Apple and WINForum Petitions and stating that "it has yet to be demonstrated that an international allocation is necessary to implement [an unlicensed high speed wireless data service] in the U.S.").

³⁶ *Id.*; Apple Comments at n.42. ARRL is mistaken that a new ITU allocation for a fixed and mobile service is required, at least for an initial "Part 15" type allocation, or that the United States' earlier decision not to include itself within Footnote 803 somehow precludes the FCC from now determining that the uses proposed by Apple and WINForum are in the public interest. ARRL Comments at 5-6. With respect to Mexican/Canadian coordination and coordination with government users, ARRL Comments at 11 n.9, this will be done as part of the general coordination process, to the extent necessary.

³⁷ As discussed in Section II(A), *supra*, Apple is committed to resolving sharing issues and has not requested that MSS feeder links be denied access to the 5 GHz band.

of NII Band devices³⁸ and some Amateur Radio Service users suggested that the Commission restrict longer-distance paths, at least in the upper 150 MHz band.³⁹

These arguments ignore three crucial facts. First, many of the point-to-point connections within a "community network" could not be built using conventional fixed microwave technologies. Commercial microwave systems offer a highly reliable service, but at a very high price,⁴⁰ and are subject to cumbersome licensing and frequency coordination requirements. As a result, they are, quite simply, not an option for many users, particularly small public service organizations with limited finances.⁴¹ If the Commission mandates that licensed microwave channels must in all cases be used for fixed point-to-point links, many links within community networks, and indeed many entire community networks, will never be built, their potential users will remain unserved, and the NII Band will be an empty promise in many areas of the country.

Second, many community networks will not require dedicated microwave spectrum. Users may need a high-bandwidth channel a few times a day or a fairly constant low rate data stream downloading information from the Internet. To mandate that each point-to-point link within a community network must use a dedicated microwave channel — whatever its capacity requirements — would be inefficient use of the spectrum and could clutter the microwave bands.

Most importantly, these users are not mutually exclusive with one another or with other spectrum users and, therefore, do not need to be moved to different technologies and higher bands in order to "preserve" the 5 GHz band for more

³⁸ LQP Opposition at 10.

³⁹ ARRL Comments at 3, 7; SCRRBA Comments at 15-16, 17.

⁴⁰ UTAM, for example, estimates that it will cost \$200,000 for each microwave link relocated from the 2 GHz band, and states that the costs for digital microwave systems may be "substantially" higher. "UTAM Plan for Financing and Managing 2 GHz Microwave Relocation," GEN Docket No. 90-314, at 27 and n.25 (filed Aug. 1, 1994). See also Comments of the Personal Communications Industry Association, RM-8643, at 5 (proposing cap on industry-shared microwave relocation costs of \$250,000 per link, plus \$150,000 when a new tower is required) (filed June 15, 1995). Even using the lowest of these estimates, a community network employing fifteen links (for example, to connect ten schools and five libraries to a central hub) would have an initial cost of approximately \$3 million.

⁴¹ E.g. Andrew Comments at 4.

traditional, smaller area unlicensed networks. Like shorter distance NII Band devices, these devices will operate at a very low power and pursuant to a set of technical rules, such as listen-before-talk, designed to protect equitable access. Moreover, these links will most likely be used in rural and similar areas, where alternatives are unavailable, and therefore it is relatively unlikely that they will be in sufficiently close proximity to other unassociated NII Band networks to adversely affect those networks' operations.

In assessing the need for unlicensed wireless community network connections, the Commission should focus on what community networks are, and what they are not. There is no single model for community networks. Most fundamentally, community networks are a resource: they will make it possible for citizens to band together through their government, their libraries, their schools, or in other collectives to connect themselves to each other and to the broader information infrastructure. Each network will evolve in the ways that are best suited to meeting the relevant community's needs, in light of local geography, communications requirements, costs, funds, and available options.

Each community network will combine a variety of technologies — including wired, licensed-wireless, and unlicensed-wireless technologies — to create an overall solution that is optimized for the local user group. Community networks will be an extension of, rather than a replacement of, other wired and wireless networks. For example, a simple community network could be created using several fixed unlicensed wireless links, each with a wireless LAN permitting mobile communications at the terminal points (*e.g.*, within each library or school).

A more elaborate network could be created by adding a connection from the network hub to the broader telecommunications infrastructure, for example, connecting to the telephone company's nearest point of presence; this connection could be over a dial-up telephone line, a dedicated fiber optic circuit, a microwave link, or an unlicensed wireless link, depending on the cost of each of these alternatives, the desired reliability, the amount of traffic to be generated, and other factors. Similarly, individual links between buildings in a network could be wired or wireless, licensed or unlicensed, depending upon what makes sense under the circumstances.

In particular, unlicensed links within a community network most likely will be used when other options are unavailable, prohibitively expensive, or unsuited to the users' needs. Given the fact that these links are low power and have non-preclusive rights to the spectrum, they are unsuited to wide area mobile communications and cannot guarantee high degrees of reliability. As a result, they will augment — but can never replicate — other wired and licensed-wireless technologies.⁴²

Unlicensed wireless technologies are an essential piece of the community network application, expanding the range of communities within which such networks are possible, as well as the potential scope of each network that is deployed. Community groups should not be denied the efficiencies and opportunities offered by unlicensed devices for longer range community network links merely because one is accustomed to thinking of unlicensed operation as short range. If community networks can operate within the NII Band without harming other NII Band users or others sharing the 5 GHz band, they should be encouraged, not prohibited.⁴³

C. **300 MHz Of Unlicensed Spectrum In the 5 GHz Range Is Required To Satisfy The Predicted Need For Wireless, Broadband Connections.**

One manufacturer argued that the Commission should initially allocate only 150 MHz of 5 GHz unlicensed spectrum, with a possible increase at a later time, apparently due to concerns that the allocation of the upper 150 MHz proposed by Apple could adversely affect Part 15 and ISM use of the upper band.⁴⁴ Several other existing or planned users of the 5 GHz band also

⁴² See Amendment of Parts 2 and 15 of the Commission's Rules to Permit Use of Radio Frequencies Above 40 GHz for New Radio Applications, Notice of Proposed Rulemaking, ET Docket No. 94-124, 9 FCC Rcd at ¶ 13 ("Certain applications, particularly those covering wide areas or requiring large investment in infrastructure, may not be able to accept the restrictions that accompany unlicensed use or, may require the additional protection from interference that can be afforded under a licensed service.").

⁴³ Several of the comments specifically mentioned the potential benefits of unlicensed wireless community networks. See, e.g. Cannon Research Comments at 2; Duncan, Weinberg Comments; ITI Comments at 4; Part 15 Coalition Comments at 3-4; Comments of J. Clifton Moyers, Jr.; Comments of L. Edward Knudson.

⁴⁴ Andrew Comments at 6.

contended that the need for a 5 GHz unlicensed allocation has not yet adequately been demonstrated.⁴⁵ These claims should be rejected.

First, an NII Band allocation would enable the development of a highly beneficial public resource that could help achieve universal service goals, expand the NII, and meet the needs of potential information "have-nots." This all could be accomplished without displacing or disrupting any existing or planned use of the 5 GHz spectrum. The NII Band, therefore, represents an optimal use of the radio spectrum and should be adopted without any reduction.

Second, bandwidth in the range of 300 MHz will be required to meet the growing demand for multi-media, graphics, and digitized video and voice transmissions. For example, an MPEG-3 compressed progressive video signal currently requires individual data streams of 18 Megabits per second. This cannot be accommodated in the recently allocated Data-PCS bands; moreover, wireless technologies must keep pace with the evolution in bandwidth requirements.⁴⁶ A high-bandwidth allocation also is necessary to support multiple users, each of whom requires a high-bandwidth connection in a crowded operating environment.

Finally, as discussed in Apple's Petition and in the various comments, these objectives cannot be met using wired technologies, licensed-wireless services, or any other existing or proposed unlicensed band.⁴⁷ The proposed 5 GHz allocation is a quantum leap forward in the development of wireless technologies. It, alone, can satisfy demand for community networks and for high-bandwidth wireless data connections, and is a necessary part of a comprehensive set of wireless alternatives.

⁴⁵ ARRL Comments at 3, 6-7, 13; FAA Comments at 3; LQP Opposition at 1, 12-14; Constellation Comments at 4-5.

⁴⁶ See, e.g., Comments of Charles C. Kankelborg (discussing high bandwidth applications in the field of astrophysics); Compaq Comments at 2-3; Microsoft Comments at 2; Motorola Comments at 2..

⁴⁷ See, e.g. Compaq Comments at 2-3; HP Comments at 3-5, 6-7; ITI Comments at 5-6; Motorola Comments at 4; Part 15 Coalition Comments at 4-5; Metricom Comments at 6-7. Contrary to LQP's suggestion, LQP Comments at 14, Apple does not claim that each of the other unlicensed bands is currently "full." Rather, it and others have explained that a 300 MHz 5 GHz allocation is needed to provide a suitable range of unlicensed wireless alternatives and that overall demand for unlicensed technologies is sufficient to justify each of the existing and proposed unlicensed allocations.

D. Technical Rules Should Be Developed During The Rulemaking Process.

The comments demonstrated strong support for the FCC adopting an NPRM that proposes the broad outlines for establishing the NII Band — in particular, a 300 MHz spectrum allocation; transmissions of data in packetized form; low power, unlicensed operation pursuant to an overarching set of technical rules designed to assure equitable access to the spectrum resource, and Part 16 operation — but leaves to industry principal responsibility for developing the specific technical rules needed to prevent interference and assure equitable sharing.⁴⁸

E. Pulson's Alternative Proposal Should Be Rejected.

Pulson Communications ("Pulson") urged the Commission to reject Apple's proposal and, instead, to clear the entire 2.5-8.5 GHz band for use exclusively by ultra-wideband technologies.⁴⁹ Pulson's proposal is not a substitute for Apple's low cost, low power, HIPERLAN-compatible NII Band. As a result, it not stand in the way of Apple's proposal.

⁴⁸ E.g. Andrew Comments at 9 n.14; Compaq Comments at 3; HP Comments at 2; ITI Comments at 6; Microsoft Comments at 1-2, 5; Motorola Comments at 3; NTI Comments at 5; Part 15 Coalition Comments at 9-10; Metricom Comments at 8. Apple wishes to clarify that its reference to an industry-based process for developing rules was meant to be broadly inclusive, not preclusive. Apple agrees that input should be sought from all affected parties and should reflect the shared expertise of those available. See, e.g., Comments of Bruce Perens (describing expertise of Radio Amateur Service users and their potential contributions to the standards setting process).

⁴⁹ Comments of Pulson Communications at 1-2.

CONCLUSION

For the reasons discussed herein and in Apple's Petition and Comments, Apple urges the FCC to respond to the overwhelming support for Apple's Petition by promptly adopting an NPRM proposing a 5 GHz "NII Band" unlicensed allocation.

Respectfully submitted,

APPLE COMPUTER, INC.

/s/ James F. Lovette

James F. Lovette
One Infinite Loop, MS: 301-4J
Cupertino, California 95014
(408) 974-1418

OF COUNSEL:

Henry Goldberg
GOLDBERG, GODLES, WIENER & WRIGHT
1229 Nineteenth Street, N.W.
Washington, D.C. 20036
(202) 429-4900

James M. Burger
Director, Government Affairs
APPLE COMPUTER, INC.
1667 K Street, N.W., Suite 410
Washington, D.C. 20006
(202) 466-7080

July 25, 1995

CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the foregoing Reply Comments of Apple Computer, Inc., was sent by first-class mail, postage prepaid, this 25th day of July, 1995, to each of the following:

- | | |
|---|--|
| *** Chairman Reed Hundt
Federal Communications Commission
1919 M Street, N.W., Room 814
Washington, D.C. 20554 | *** Mr. David Siddall
Office of Comm. Ness
Federal Communications Commission
1919 M Street, N.W., Room 832
Washington, D.C. 20554 |
| *** Hon. James Quello
Federal Communications Commission
1919 M Street, N.W., Room 802
Washington, D.C. 20554 | *** Ms. Jill Luckett
Office of Comm. Chong
Federal Communications Commission
1919 M Street, N.W., Room 844
Washington, D.C. 20554 |
| *** Hon. Andrew C. Barrett
Federal Communications Commission
1919 M Street, N.W., Room 826
Washington, D.C. 20554 | *** Mr. Richard M. Smith
Chief
Office of Engineering & Technology
Federal Communications Commission
2000 M Street, N.W., Room 480
Washington, D.C. 20554 |
| *** Hon. Susan Paula Ness
Federal Communications Commission
1919 M Street, N.W., Room 832
Washington, D.C. 20554 | *** Mr. Bruce Franca
Deputy Chief
Office of Engineering & Technology
Federal Communications Commission
2000 M Street, N.W., Room 480
Washington, D.C. 20554 |
| *** Hon. Rachelle B. Chong
Federal Communications Commission
1919 M Street, N.W., Room 844
Washington, D.C. 20554 | *** Mr. Mike Marcus
Office of Engineering & Technology
Federal Communications Commission
2000 M Street, N.W., Room 480
Washington, D.C. 20554 |
| *** Ms. Ruth Milkman
Office of Chairman Hundt
Federal Communications Commission
1919 M Street, N.W., Room 814
Washington, D.C. 20554 | *** Mr. Robert M. Pepper
Chief
Office of Plans & Policy
Federal Communications Commission
1919 M Street, N.W., Room 822
Washington, D.C. 20554 |
| *** Mr. Rudy Baca
Office of Comm. Quello
Federal Communications Commission
1919 M Street, N.W., Room 802
Washington, D.C. 20554 | |
| *** Mr. Keith Townsend
Office of Comm. Barrett
Federal Communications Commission
1919 M Street, N.W., Room 826
Washington, D.C. 20554 | |

*** Mr. Donald Gips
Deputy Chief
Office of Plans & Policy
Federal Communications Commission
1919 M Street, N.W., Room 822
Washington, D.C. 20554

*** Mr. Michael Katz
Chief Economist
Office of Plans & Policy
Federal Communications Commission
1919 M Street, N.W., Room 822
Washington, D.C. 20554

*** Mr. Thomas P. Stanley
Chief Engineer
Office of Plans & Policy
Federal Communications Commission
1919 M Street, N.W., Room 822
Washington, D.C. 20554

*** Mr. Mark Corbitt
Office of Plans & Policy
Federal Communications Commission
1919 M Street, N.W., Room 822
Washington, D.C. 20554

Larry Irving, Esq.
National Telecommunications and
Information Administration
14th Street & Constitution Avenue., N.W.,
Room 4898
Washington, D.C. 20232

Mr. Richard D. Parlow
National Telecommunications and
Information Administration
14th Street & Constitution Avenue., N.W.,
Room 4898
Washington, D.C. 20232

Mr. William D. Gamble
National Telecommunications and
Information Administration
14th Street & Constitution Avenue., N.W.,
Room 4099A
Washington, D.C. 20232

Mr. W. Bowman Cutter
National Economic Council
Old Executive Office Building
17th Street & Pennsylvania Avenue, N.W.,
Room 231
Washington, D.C. 20500

Mr. Tom Kalil
The White House
National Economic Council
Old Executive Office Building
17th Street & Pennsylvania Avenue, N.W.,
Room 233
Washington, D.C. 20500

Mr. Lionel S. Johns
The White House
Office of Science and Technology Policy
Old Executive Office Building, Room 423
17th Street & Pennsylvania Avenue, N.W.
Washington, D.C. 20506

Mr. Robert Bonometti
The White House
Office of Science and Technology Policy
Old Executive Office Building
17th Street & Pennsylvania Avenue, N.W.
Washington, D.C. 20506

Michael Senkowski, Esq.
Eric W. DeSilva, Esq.
Wiley, Rein & Fielding
1776 K Street, N.W.
Washington, D.C. 20006

Aaron Laramore
Organized Neighbors Yieldings Excellence
Inc.
933 Pinewood
Toledo, Ohio 43607

Robert J. Miller, Esq.
Gardere & Wynne, L.L.P.
1601 Elm Street, Suite 3000
Dallas, Texas 75201
Counsel for Alcatel Network Systems,
Inc.
Of Counsel for Telecommunications
Industry Association

Alec Rowell
8451 S.E. 39th Street
Mercer Island, Washington 98040

Christopher D. Imlay, Esq.
Booth, Freret & Imlay
1233 20th Street, N.W., Suite 204
Washington, D.C. 20036
Counsel for American Radio Relay
League, Incorporated

Berry J. Turock, President
Amerian Library Association
110 Maryland Avenue, N.E.
Washington, D.C. 20002-4675

William J. Kaiser
Amateur Radio Station N6OLD
38389 Nebo
Fremont, California 94536

Catherine Wang, Esq.
Swidler & Berlin, Chartered
3000 K Street, N.W.
Suite 300
Washington, D.C. 20007
Counsel for Andrew Corporation

Arnold Karush
3253-25 Caminito Eastbluff
La Jolla, California 92037

Mark C. Rosenblum, Esq.
Kathleen F. Carroll, Esq.
Ernest A. Gleit, Esq.
AT&T Corp.
Room 3252F3
295 North Maple Avenue
Basking Ridge, New Jersey 07920

Barton L. Preecs
1629 Davison
Richland, Washington 99352

Mr. M Carling
Bay Area NeXT Group
P.O. Box 1731
Palo Alto, California 94302

Bruce Perens
c/o Pixar
1001 W. Cutting Boulevard, Suite 200
Richmond, California 94804

Daniel J. Weitzner
The Center for Democracy and Technology
1001 G Street, N.W.
Suite 700 East
Washington, D.C. 20001

Chester Wm. Rindfuss
23850 140th Lane SE
Kent, Washington 98042

Christopher M. Mays
496 Fairbanks Avenue
Oakland, California 94610

Joseph Tasker, Jr., Esq.
Federal Government Affairs
Compaq Computer Corporation
1300 I Street, N.W., 490 East
Washington, D.C. 20005

Ian D. Volner, Esq.
William D. Coston, Esq.
Venable Baetjer, Howard & Civiletti
1201 New York Avenue, N.W., Suite 1000
Washington, D.C. 20005
Of Counsel to Compaq Computer
Corporation

Frank B. Withrow, PhD.
Council of Chief State School Officers
One Massachusetts Avenue, N.W.
Suite 700
Washington, D.C. 20001-1341

David Thielen
4628 Old Pond Drive
Plano, Texas 75024

David M. Shaw
5929 Ayala Avenue
Oakland, California 94609-1507

Dewayne Hendricks
Warp Speed Imagineering
43730 Vista Del Mar
Fremont, California 94539-3204

Kenneth O. Beckman
Digital Equipment Corporation
Systems Research Center
130 Lytton Avenue
Palo Alto, California 94301-1044

Harold K. McCombs, Jr.
Janice L. Lower
Barry F. McCarthy
Michael R. Postar
Tanja M. Shonkwiler
Duncan, Weinberg, Miller & Pembroke
1615 M Street, N.W., Suite 800
Washington, D.C. 20036

Gerald E. Stroufe
The American Educational Research
Association
1230 Seventeenth Street, N.W.
Washington, D.C. 20036

David Byer
Education Policy Manager
Software Publishers Association
1730 M Street, N.W., Suite 700
Washington, D.C. 20036

Thomas A. Shannon
Executive Director
National School Boards Association
1680 Duke Street
Alexandria, Virginia 22314

Edward Epley
3053 NW Harrison
Corvallis, Oregon 97330

Gary Fisher
11352 Rosewood Avenue
Allendale, Michigan 43411-0534

Fiona J. Branton
Information Technology Industry Council
1250 Eye Street, N.W., Suite 200
Washington, D.C. 20005

John Otken
3607 Greystone #211
Austin, Texas 78731

Kenneth J. McCarthy
e-media
2130 Fillmore Street - 288
San Francisco, California 94115

David Caulkins
Knowledge Industries
350 Cambridge Avenue, Suite 385
Palo Alto, California 94306

Mark Kohler
Intellex Computer Consulting
7234 Life Quest Lane
Columbia, Maryland 21045

Michael Chui
239 Ashton Weatherly
Bloomington, Indiana 47406

Michael Gersten
1255 McNell Road
Ojai, California 93023

Michael Pearce
P.O. Box 1293
Portland, Oregon 97207

Stuart Overby
Motorola Inc.
1250 Eye Street, N.W.
Suite 400
Washington, D.C. 20005

Shelly Weinstein
President/CEO
National Education Telecommunications
Organization/Educational Satellite
1735 I Street, N.W., Suite 601
Washington, D.C. 20006

Stephen L. Goodman, Esq.
Halprin, Temple & Goodman
1100 New York Avenue, N.W.
Suite 650, East Tower
Washington, D.C. 20005
Counsel for Northern Telecom Inc.

John G. Lamb, Jr.
Northern Telecom Inc.
2100 Lakeside Boulevard
Richardson, Texas 75081-1599

John E. Cunningham
Paul Wittington
Pulson Communications
Suite 1800
200 Galleria Parkway
Atlanta, Georgia 30339

Andrew Huang
Qualcomm, Inc.
4021 Clairemont Drive
San Diego, California 92117

Roger Hendricks
University of Florida
E520 CSE
P.O. Box 116140
Gainesville, Florida 32611-6140

Roy McCrory
P.O. Box 80122
Albuquerque, New Mexico 87198-0122

Scott Busby
Computer Services Manager
Twin Oaks Community
RR4, Box 169
Louisa, Virginia 23093

Scott Zelakiewicz
220 W. Fairmount Avenue
State College, Pennsylvania 16801

Michael Silverberg, D. Phil.
Stonybrook Health Sciences Center
State University of New York at Stony
Brook
Stony Brook, New York 11784-8161

Susan D. Prince
P.O. Box 536
Alta, California 95701

Ted Krovetz
161 Peach Terrace
Santa Cruz, California 95060

George M. Kizer, Chairman
Dennis Couillard, Vice Chairman
Eric Schimmel, Vice President of TIA
Fixed Point-to-Point Communications
Section,
Network Equipment Division of the
Telecommunications Industry
Association
2500 Wilson Boulevard, Suite 300
Arlington, Virginia 22201

Walter L. Purdy
Gary G. Allen
Triangle Coalition for Science and
Technology Education
5112 Berwyn Road
College Park, Maryland 20740-4129

Debby Coleman, President
Paul H. Lewis, Chair
South Carolina Library Association
1167 Ridgemont Drive
Aiken, South Carolina 29803

David A. Ross
Department of Veterans Affairs
Atlanta VA Rehab R&D Center
Mail Stop 151R
Atlanta VA Medical Center
1670 Clairmont Road
Decatur, Georgia 30033

Bruce Umbaugh
Assistant Professor of Philosophy
Webster University
470 East Lockwood Avenue
St. Louis, Missouri 63119-3194

Mark D. LeBlanc
Wheaton College
Department of Mathematics
Norton, Massachusetts 02766

R. Michael Senkowski
Eric W. DeSilva
Wiley, Rein & Fielding
1776 K Street, N.W.
Washington, D.C. 20006
Counsel to Wireless Information
Networks Forum (WINForum)

Leonard Robert Raish, Esq.
Fletcher, Heald & Hildreth, P.L.C.
1300 North 17th Street, 11th Floor
Rosslyn, Virginia 22209
Counsel to Harris Corporation - Farinon
Division and Digital Microwave Corp.

John T. Scott, III
William D. Wallace
Crowell & Moring
1001 Pennsylvania Avenue, N.W.
Washington, D.C. 20004-2505
Counsel to Loral/Qualcomm
Partnership, L.P.

Leslie A. Taylor
Leslie Taylor Associates
6800 Carlynn Court
Bethesda, Maryland 20817-4302
Counsel to Loral/Qualcomm
Partnership, L.P.

Walter M. Lamia
2397 Delo Drive
Gibsonia, Pennsylvania 15044

James G. Kimball
Pacific Valley #4
Big Sur, California 93920

Michael Papadopoulos Ph.D.
5370 NW Lawrence Avenue
Corvallis, Oregon 97330

Philip Wadler
Professor of Computing Science
University of Glasgow
8-17 Lilybank Gardens
Glasgow, G12 8RZ
SCOTLAND

John R. Levine
I.E.C.C.
P.O. Box 92
Trumansburg, New York 14886-0092

Harry Bartholomew
3006 Mc Glenn Drive
Aptos, California 95003

Noel Dunne, Director
SLU Christian Community Services
P.O. Box 984
Alamosa, Colorado 81101

John C. Krawczuk
61-44 Madison Street
Ridgewood, New York 11385

Steven Peters
11911 Laurie Lane
Houston, Texas 77024-5032

Richard Hodges
P.O. Box 1696
Dayton, Nevada 89403

Ralph C. de Juliis
101 Kearney Street
Paterson, New Jersey 07522-1901

Philip L. Dubois
2305 Broadway
Boulder, Colorado 80304-4132

Brad Neuberg
P.O. Box 4568
McAllen, Texas 78502

Christopher A. Grasso
18990 W. 60th Place
Golden, Colorado 80403

Gerald J. Markey
Program Director for Spectrum Policy and
Management
Federal Aviation Administration
800 Independence Avenue, S.W.
Washington, D.C. 20591

Robert McConnell Productions
6018 West Hellis Drive
Muncie, Indiana 47304

Leonard T. Roberts
607 King Arthur Drive
Gastarre, North Carolina 28056

Leilani Wright
511 N. MacDonald
Mesa, Arizona 85201

Charles L. Betby
1234 Prospect
Ann Arbor, Michigan 48104

Gerald Swatez
39930 Whitewood Road
Murrieta, California 92563-6503

Dr. Dale Fitzgibbons
3004 Forsythe Court
Peoria, Illinois 61614

Don Wallenberg
P.O. Box 4447
Santa Rosa, California 95402

Glenn Trewitt
1153 Sesame Drive
Sunnyvale, California 94087-2421

David McAllister
1923 El Dorado Drive
Salt Lake City, Utah 84124

W. H. Kirn
3201 Cobblestone Drive
Santa Rosa, California 95404

Phil Pfeiffer
Computer Science Department
East Stroudsburg University
200 Prospect Street
East Stroudsburg, Pennsylvania 18301-2999

David Winet
1084 Silek
Berkeley, California 94705

Karen Pedersen and Hugh King
3596 Tacoma Avenue
Los Angeles, California 90065

William B. Baggott
12640-K Briarglen Loop
Stanton, California 90680

Gary Wynn Kelly
2621 Willowbrook Lane, #107
Aptos, California 95003

W. Robert Keeney
Eastern Shore Public Library
P.O. Box 360
Accomac, Virginia 23301

LeRoy M. Lefkowitz
Times Technology Transfer Corporation
13715 Pine Needles Drive
P.O. Box 2828
Del Mar, California 92014

David Cabana
3103 Phoebe Lane
Delray Beach, Florida 33444

Claude Van Horn
1519 W. Allison Road
Cheyenne, Wyoming 82007

John Watlington
MIT Media Laboratory
Room E15-351
20 Ames Street
Cambridge, Massachusetts 02139

Pascal Chesnais
MIT Media Laboratory
Room E15-348
20 Ames Street
Cambridge, Massachusetts 02139

Klee Dienes
MIT Media Laboratory
Room E15-349
20 Ames Street
Cambridge, Massachusetts 02139

Sheri Edwards
202 Stevens Avenue
Coulee Dam, Washington 99116

Mark P. Anderson
431 Center Avenue
Runnemede, New Jersey 08078

Paul C. Kainen
3044 N Street, N.W.
Washington, D.C. 20007

Roger W. Franz
3414 H We Avenue
St. Ann, Missouri 63074

David Goodbary
80 Greendale Drive
St. Louis, Missouri 63121

L. C. Armstrong
America Online Internet Connection
3325 Simpson Avenue, Apt. C
Ocean City, New Jersey 08226-2098

Erik Mavrinac
3605 NE 73rd Place, #7
Seattle, Washington 98115

Jeffrey A. Kline
92 Grand Street
Ferguson, Oregon 91402-4282

M. Robin Critchell
Southern California Repeater and Remote
Base Association
P.O. Box 5967
Pasadena, California 91117

Henry M. Rivera
Larry S. Solomon
Ginsburg, Feldman & Bress, Chtd.
1250 Connecticut Avenue, N.W.
Washington, D.C. 20036
Counsel for Metricom, Inc.

Eva Marie and Gerald J. Klaas
5109 Melvin Drive
Carmichael, California 95608

Glen R. Parker
65 Westbourne
Brookline, Massachusetts 02146

Kenneth Ingham
1601 Rita Drive, N.E.
Albuquerque, New Mexico 87106-1127

Jeff Coch
1027 Victoria Avenue
Venice, California 90291